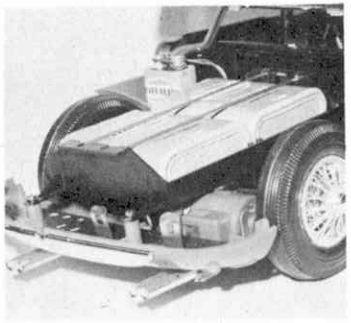
Shows location of good stout batteries over rear axle of a car. Note electric motor front right – driving road wheels by spur gears. Battery in background standing up is for receiver.

SUMMING UP

This booklet rambles over quite a lot of ground, suggesting various ways in which R/C model cars can be tackled. It is not intended to do more at this stage than set you thinking, doodling perhaps, on scraps of paper and working out a dream car. In our next month's instalment we shall go into precise detail for building 'Ca' Canny', a freelance racing car. We shall also show how to motorise and fit simple R/C gear into two readily available plastic kit models for the benefit of those who do not want to make it all.

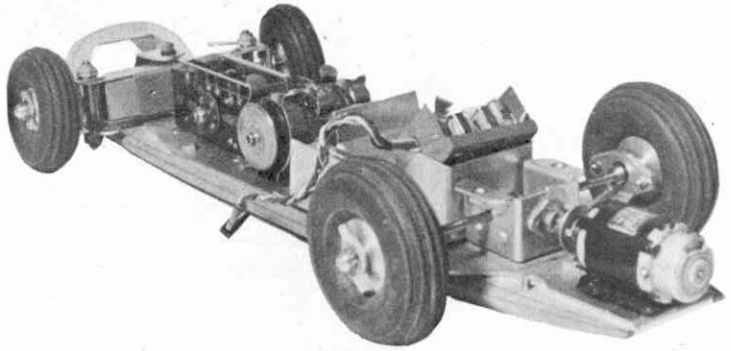
The Ferrari model illustrated and on sale complete with receiver and transmitter from Beatties of London and other firms – mainly as an introductory toy! – will also be available as a construction kit, using the scale body, and with a fully steerable Akerman unit, electric motor, etc. Some of these cars will be demonstrated at our Model Engineer



Exhibition in January . . . and certainly take the problems out of building!

Finally, we would again remind readers that to operate radio control equipment, they must obtain a Model Control Licence . . . this costs 30/- for five years and is available from G.P.O. Radio & Broadcasting Dept., Waterloo Bridge House, Waterloo Road, London, S.E.1. *There is NO examination – just a simple bit of form filling!*

Shows what goes under the balsa body on Mr. Hadley's racing car. Note quite powerful electric motor here – and the smart gearbox with crown wheel and pinion installed.



SUPPLEMENT WITH MECCANO MAGAZINE, DECEMBER 1969

RADIO 4-2

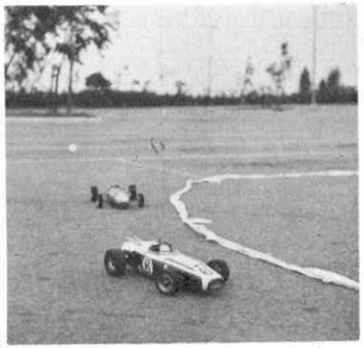
INTRODUCTION TO SIMPLE CONTROL OF

MODEL CARS

INTRODUCTION

The Cinderella of Radio Control is undoubtedly the land vehicle which includes cars, lorries, chara-bancs and half-track vehicles such as tanks and Bren-gun carriers. It is difficult to know why this should be so, since there are probably more suitable places for operating a model on land than there are flying fields or lakes for aircraft or boats.

To consider first of all where one should operate a model car we can list at once any reasonably smooth school playground, a hard tennis court, a parking area which is reasonably smooth in a non-busy time, any cul-de-sac, a concrete driveway to the garage at home, the floor of the garage itself, and a hall large enough for badminton. In fact, the number of places are so numerous that it is just incomprehensible why nobody seems ever to be using them for this purpose.



Typical cars racing on a smooth surface in the open air. In this case heavy tapes have been laid to outline course – alternatives could be hosepipe, rope or even garden edging.

WHAT SIZE TO BUILD

What size to build a model car or other land vehicle is determined by two things; the availability of parts which can be obtained ready-made and the skill of the builder in producing miniaturised electronic items to go into the model size chosen. To start with, the most difficult size we would consider is 1/32nd scale. It is a great pity that it is difficult to put radio control in so small a model, because there is a greater variety of mechanical parts in this scale ready for use at moderate prices than in any other. It has the added advantage that in this small size the model will not be much more at the most than seven or eight inches long and be operated in any convenient corridor or linoleum covered room, and still have ade-

quate room to manoeuvre. Some quite interesting and highly successful models have been radio-controlled using 1/32nd scale Airfix kits, saloon type, but we do not recommend it to the newcomer, since it demands a high degree of skill in miniaturising the parts. The amount saved in using a small and reasonably priced kit will be absorbed by the high price of miniature components, if they are bought ready-made; and we doubt the available skill if they are not bought ready-made. Anyone successfully attempting this sort of model will not need our help or comment on the electronic side, he'll know it already!

The next size up is 1/24th scale, that is half-an-inch to the foot, and with growing interest in this size for model racing there is a good stock of parts, wheels and so on, as well as kits available. We have now a size which is almost practical to use for comparatively unskilled radio controlled work. It does not leave the whole field of cars available, some in 1/24th scale are still distressingly small, but if we consider larger saloon cars then it is quite possible to get the necessary works in. We should add a cautionary note here that, although it is possible to get the parts in, we shall be running our car on batteries for driving power. There will not be room for a large battery which would be the most economical in operation; we must use small batteries which will need more frequent replacement so that the running cost of the model will still be higher than we would really like.

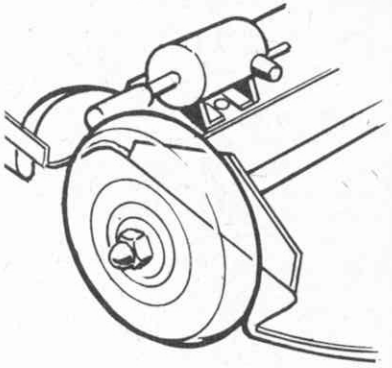
Still going on in size we come to 1/16th scale and we have what could be a very nice compromise size, neither too big to be operated except in a large area, nor too small to be manageable from the skill point of view. Unfortunately in this scale there is only

Ferrari model in plastic by Mainstream in kit form, with steering, motor, body, battery box, sells at £4-19-6.

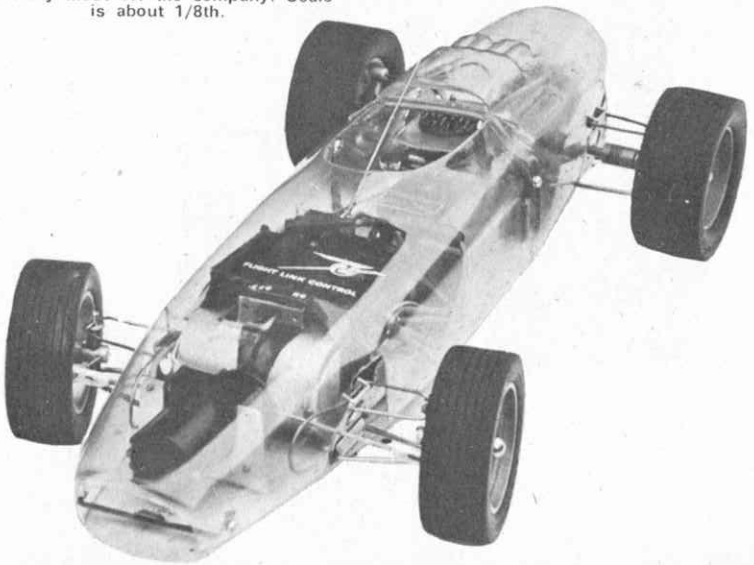
gines like this in an aircraft or a model boat . . . You may even have such a motor waiting to be used! Do *not* run such a model indoors except on a wood or stone floor, or at least covered with lino. It is really better to perform outside on the patio, school playground or other smooth hard surface where fuel drips will pass unnoticed.

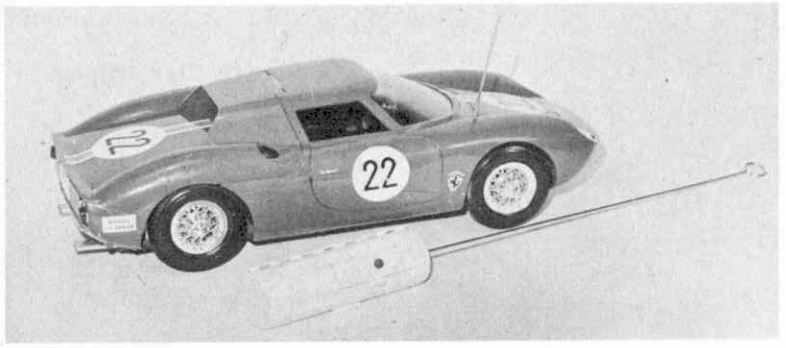
You will need a flywheel as well as the motor – just as you would with a boat motor. Your anchoring points and pan base of the car will have to be more robust than with an electric motor. Also important is the need for proper cooling when running. This can be achieved through a proper radiator grille at the front; by omitting windscreen glass in a saloon, or by an open cockpit in a racing car.

Elegant R/C powered model by Flight Link Control. This one has a transparent shell to show the working of controls, normally it would be appropriately painted. Wheels here are specially made for the company. Scale is about 1/8th.



Shows how motor can be mounted by road wheel, and then can drive it by means of a sleeve on the drive shaft. Simple and practical.

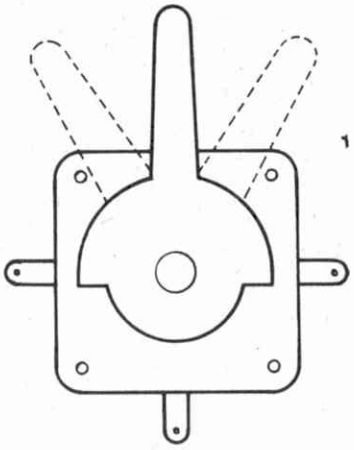




The Mainstream Ferrari shown with its simple transmitter beside it. Ready to run, the outfit in expanded polystyrene box costs only about £16. Range is limited – but no limit to the fun! Beatties of London have it in stock.

follow the contrate gear system, where a small crown wheel is fixed to the axle and a toothed gear to the motor shaft which will give a ratio of from $2\frac{1}{2}$ to 4 to 1. Use of Meccano gears from their transport sets can also be advised, especially if you choose a fairly large scale to work in. With the space available it will also be possible to instl a motor to drive the road wheels via spur gears. This is good, since it is a simple gear chain, and there are fewer power losses by unwanted friction than will be inevitable with a crown wheel type of drive.

However, the reader will have noted that most of our pictures show cars with small diesel or glowplug motors installed. This is because they show more advanced models than we are, as yet, considering, but there is no reason whatsoever not to fit a small internal combustion engine, particularly if you already have some experience of operating en-



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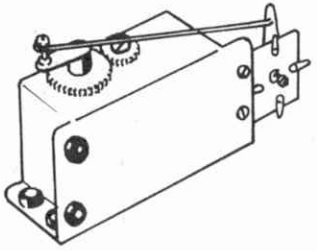
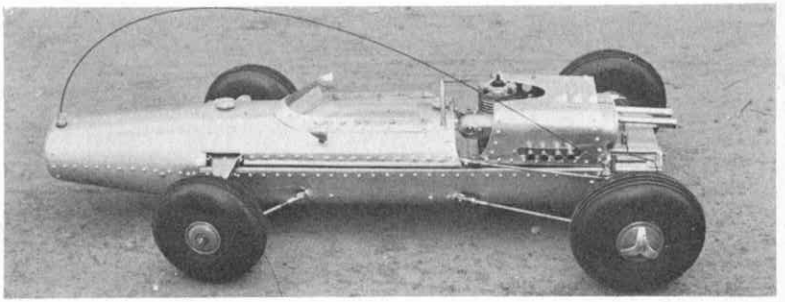
Switcher panel. Level can be pulled or pushed as per dotted lines, connecting circuits through to left or right. Below, it is shown fitted to a servo unit as compactly as possible. This provides three positions: upright (say straight ahead), left and right.



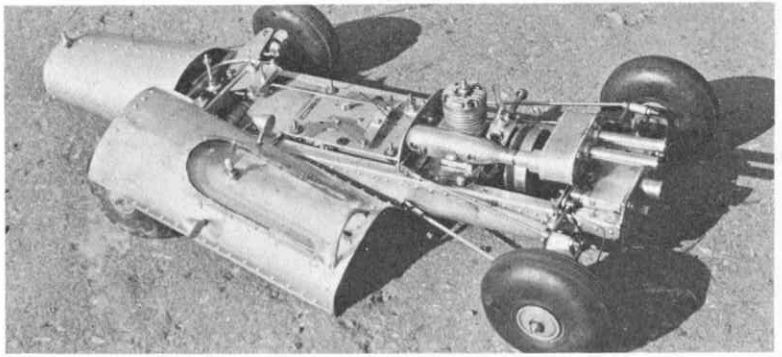


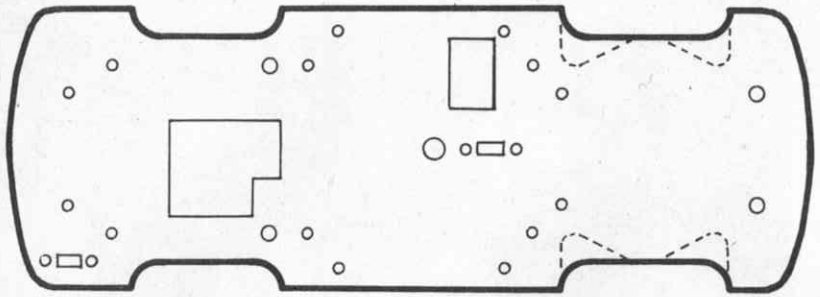
What can be done! A metal-bodied (rivets and all) car in 1/8th approx. scale with glow-engined power. This is for multi-channel.
The same car is shown below with centre panel removed.

a moderate number of kits available; it is really a question of shopping around and seeing what can be bought. Frog offer motorised car kits in 1/16th scale which include a Ford Cortina and a Morris 1100 which we have seen. We have not seen them about as much as we should have liked, but the price is reasonable at about £1. There are also one or two that Riko have imported in the Bandai range, though here these delightful motorised cars are a little more expensive at between £2 and £3.

The next practical size is 1/12th scale or one inch to the foot. Here the supply of kits from which parts could be used is limited in the main to rather delightfully detailed racing cars such as the Tamiya cars which, although truly to the 1/12th scale, nevertheless, being Grand Prix cars, do not offer much space to put the bits and pieces, nothing for example, to compare in space with a saloon car of a smaller scale. Some of the G.T. cars, however, meet the need admirably.

A thought arises here, we have now got to a good working size, and if we ignore the kit position, we can consider what it is possible to make with limited





Typical outline for a chassis pan. Dotted lines show cutaway to allow wheels to steer and act as stops. Other marks are fixing holes and location of gear.

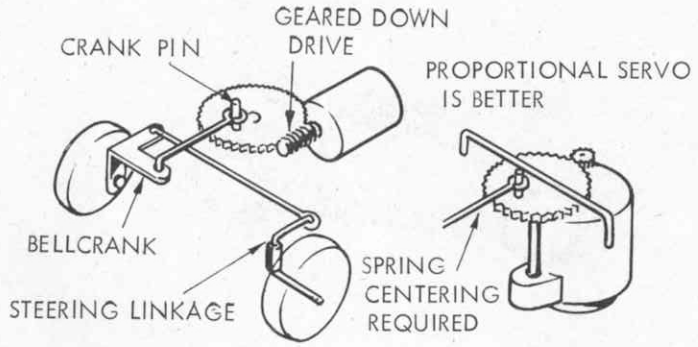
resources. No longer can we rely entirely upon kit parts and we must shop around for robust substitutes that we can use. In this connection the solid rubber wheels offered for model aircraft in their larger sizes present distinct possibilities.

BUILDING A SCRATCH CAR 1/12th SCALE

As a first project, we offer the reader a freelance car in what is approximately 1/12th scale using model aircraft wheels and following a design based freely on the popular wedge type of car which in various forms has been so successful in Grand Prix racing this year.

We have taken a wedge which enables a simple wood body and underpan to be constructed and have allied to this one of the fascinating airfoils which have been the subject of so much controversy in full-size circles during the year. It doesn't produce a car which is precisely like anything, but it does follow contemporary design and thought, and could be attractive. We are going to call it CA'CANNY, it is up to you what you call yours.

Interesting novelty model from Japan – a model Jeep which pulls trailer bearing a boat (itself R/C in turn!). It does serve to show yet another twist that can be given to a model project.



Some more suggestions by R. H. Warring for proportional steering. These come from his book mentioned above. Read also his Single Channel Radio Control *(Model & Allied Publications Ltd.)*.

earlier the whole steering unit can be adjusted to give a slight bias for left or right-hand circle if you feel this is going to be a help in free running of the car between signals.

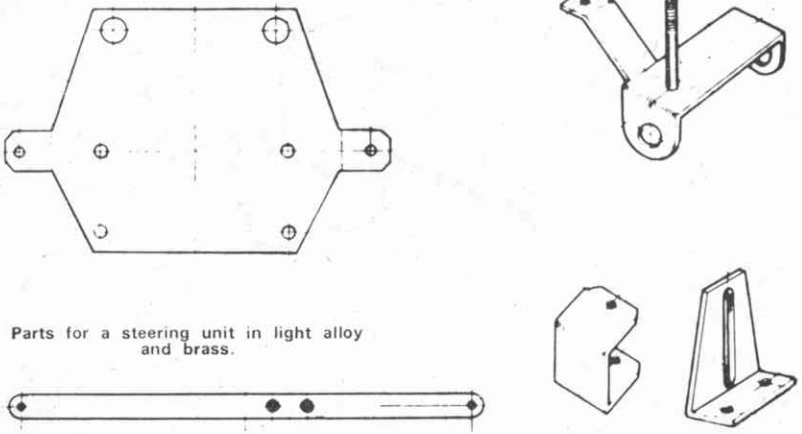
REFINEMENTS

We have considered so far only a car with a left, right or straight ahead arrangement operating by what the radio control people call 'bank bang'. This gives, as we have mentioned, a somewhat jerky effect, so that there may be a demand for a slow and precise steering arrangement, that is to say, a proportional movement. This can be done, but it has snags in that your signal will always wish to complete the whole sequence. You can, therefore, have the odd situation that if you are turning, say, to the right, and you have already made a right turn you will have to go through the whole business of a full left turn before the device comes back to the right! This is one of the problems which we have mentioned. We do feel that, at any rate, in the early stages of operating a car, the 'bang bang' operation is adequate.

HOW TO POWER YOUR MODEL

Nearly every beginner will be well advised to choose a simple electric motor to power his first model. It is simple, clean (no trouble with spills on the dining room carpet!) and introduces no particular skills beyond connecting up batery pack to give forward motion. Many of the little Japanese motors already mentioned for boat operation can be utilised here. The transfer of power from the motor to the road wheels of the car can be tackled in various ways.

The simplest of all is to slice a tight piece of rubber or neoprene tube over the motor shaft and let this rest against the tyre of the car. It will give a slow, steady speed, have nothing to go wrong and involve the least 'works'. Another motor can be fitted to press against the other road wheel – thus giving you the simplest twin-engined car ever. Those who have already had experience of slot car racing will wish to

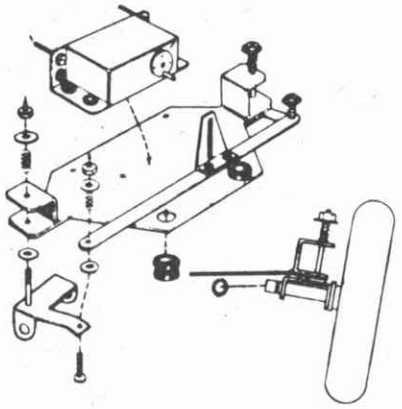


Parts for a steering unit in light alloy and brass.

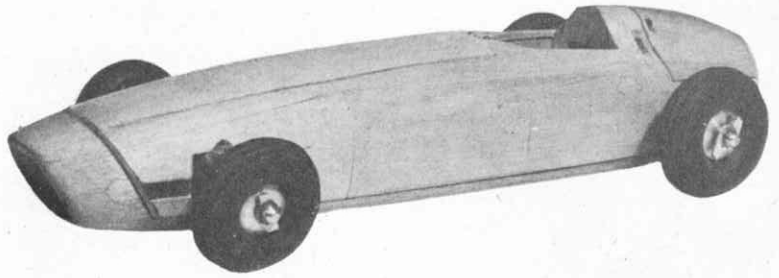
washer underneath which holds the metal washer away.

When it's soldered, you can pull away this little paper washer and so leave a little play in the wheel which should spin very freely.

Now if we place the stub axle in the holes which you will note are shown on the beams, it is firmly fixed in place once the top part of the beam is screwed down on the spacer. The little link which has been bent on to the other piece of the stub axle will fit onto the track rod and you will see it links up with the other wheel and the front axle assembly is very nearly finished. The whole unit bolts down on to the base plate or under pan of the car, and you are ready to instal the servo which will move the linkage at the centre. It is a good idea to arrange a self-centreing device which can be either a light spring or a couple of elastic bands. One or two alternative methods of making this steering assembly are also shown. You may be lucky enough to have some old bits of electric light fittings which serve for the parts we have bent up. If you have any useful Meccano pieces, they also can be pressed into service, provided the scale of the model you are building leaves room for them to be installed. As an added refinement we have mentioned



Parts shown above assembled. Note camber of wheel in full-size style.



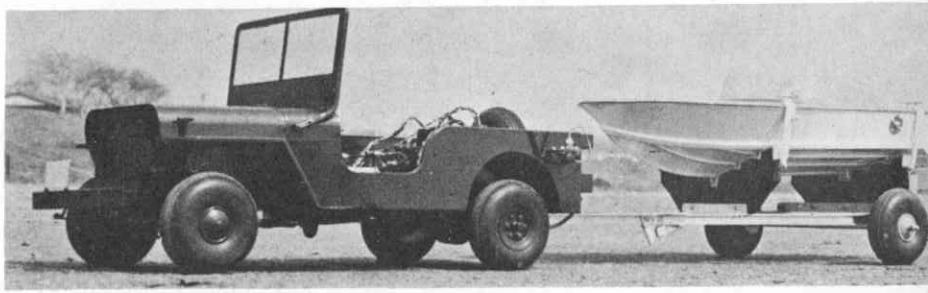
Balsa body and ex-aero wheels from Keilkraft and Graupner show how the job can be done from available supplies. This model was made by J. A. Hadley and appeared in *Model Cars*.

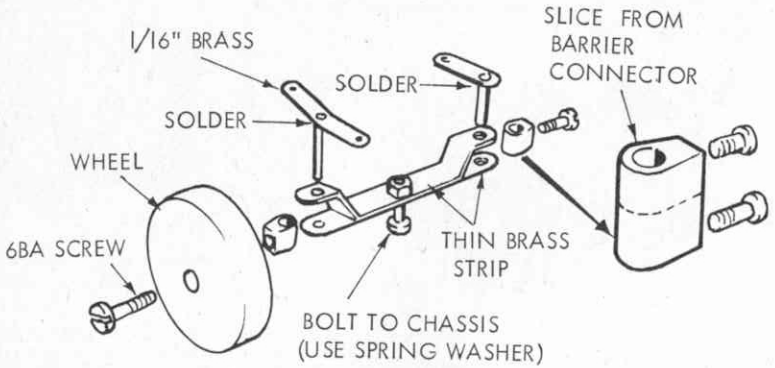
We are using two pairs of wheels of different sizes, because this is a quite usual thing in full-size circles. We have just over 2-inch diameter wheels for the two front wheels and about 2½ ins. for the rear wheels. We have decided on a 7 ft. 6 in. scale wheelbase which places the wheel centre 7½ inches apart in one inch to the foot scale, and we are going to have approximately 5 ft. track for the rear wheels, and 4 ft. track for the front wheels which gives them a position of 4 ins. apart and 5 ins. apart centre to centre, which now begins to establish the general shape of the car.

The bonnet will extend in front of the front axle and the tail will extend beyond the rear axle line, giving us an overall length of approximately 12 inches. If we allow an axle clearance for the underpan of 6 in., that means we can bring our bottom of the car to within ½ inch of the ground, which should give it a nice low ground-hugging appearance.

Let us therefore then, construct our body of ⅛ ply, or even a good hard balsa as the bottom of the pan; the body itself is constructed of either balsa or light ply, or could even be of card. Details of this construction will be given in the final instalment.

At this stage, having arrived at a basic car shape and size, we will go over now to consider some of the mechanical elements of such a model. The previous



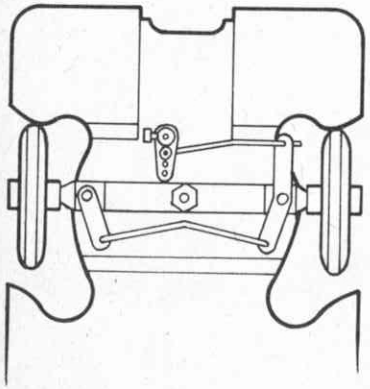


Simple steering layout from brass strip. Meccano parts could also be used. From a plastic bus R/C installed by D. Bollen.

instalments of this series have dealt with the radio and electronic problems encountered in single channel operations so that it should not be necessary for us to recapitulate, we prefer to devote time and space to mechanical aspects of a land vehicle which have not previously been covered in the series, or indeed, to any extent in any contemporary literature.

STEERING A MODEL CAR

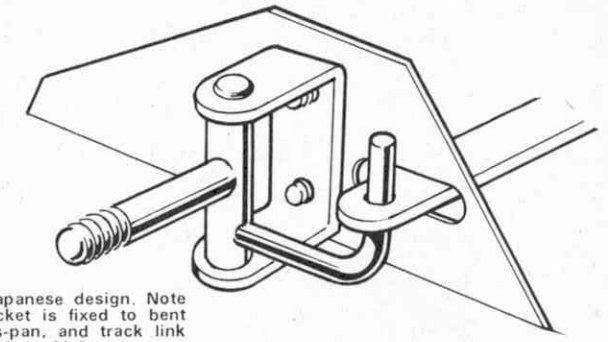
The obvious way to steer a model car is with the front wheels turning just as in a full-size car,



The same steering mechanism in place. Cranking the tie-rod and link adjusts for true running. Note how cutaway acts as limit stop for steering turn.

to the left or to the right, or straight ahead, according to what is required of the vehicle. This is normally referred to as Ackerman steering and a diagram shows how it should be ideally arranged. In a small model like this we needn't really worry over the finer points of such a design, such as toe-in and the exact angle at which the king pin goes, but just a general basic notion.

With single channel radio we must remember we haven't a lot of controls, so it would be a good thing to have our steering so arranged that it will normally go straight ahead if no signal is given. We can have an adjustment to angle the steering so that it can either go straight or it can go nearly straight ahead, that is to say, making a very large circle. Such an arrangement would be suitable for operating a car say, on a school playground or a tennis court. This adjustment



Steering from a Japanese design. Note how kingpost bracket is fixed to bent up part of chassis-pan, and track link comes through a slot which acts as a limit stop.

solder over your soldering iron head so that you have coated the head of your iron with a coating of thin solder. Dip the soldering iron in the fluxite again and bring the solder stick and your iron together where you are going to join, and you will find it will melt into a very nice blob and will run into all the areas where you have the flux, which helps to make it flow.

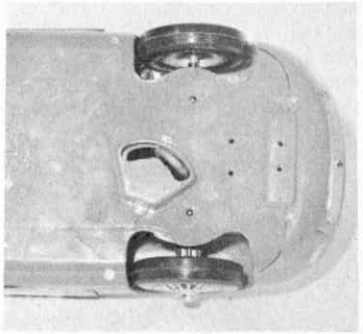
This first effort will probably be very ugly and blobby, but if you leave it for a few minutes until it gets cold and tug at it you will find you have a secure joint. When you are more skilled, you will be able to use the iron on the solder to make it flow just as you wish, and produce a beautiful smooth finish but this is for your more expert days. If you are already good at soldering, you can ignore this beginner's guide.

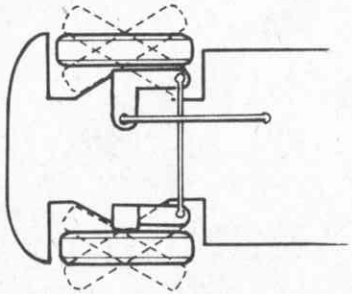
For neatness, a little round washer soldered on additionally to the stub axle makes a fine resting place for the wheel to butt against, but this again is a matter of refinement.

Underneath the Mainstream Ferrari. Jockey wheel swings back and forth to provide steering in reverse position – otherwise in forward motion the car goes straight ahead. Wheels do not actually touch the ground appreciably.

It is shown in the drawing as done, but if you don't want to do it, then it's up to you. Similarly, if you haven't got a washer and you want to stand the wheel off away from the stub axle, then a short length of brass tubing which you have cut with a file or a fine saw will do the job just as well.

Now comes the problem of keeping the front wheel on the stub axle. The stub axle itself should go through the hole in the wheel hub and protrude ideally not more than $\frac{1}{8}$ in. A little washer is soldered on the very end. So that you leave the wheel still free to run, you should have a little thin paper or thin card



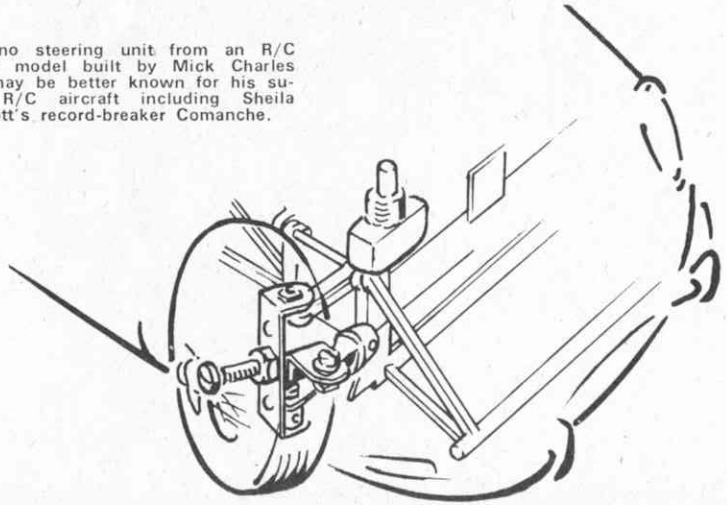


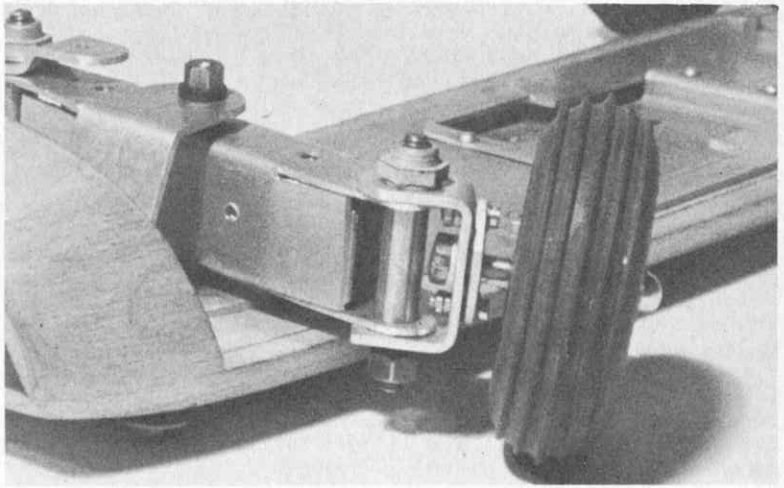
A very simple steering layout – probably the simplest possible. From R. H. Warring's book 'Radio Control Models' *(Museum Press)*.

wire. There is no need to be nervous about the soldering aspect. If you have bound the two pieces together as shown and put them in their little jigs, quite a rudimentary piece of soldering using any old soldering iron to hand will be adequate for holding the pieces together. If you don't do it very expertly it won't look so neat but will probably be quite strong enough.

If you have not done any soldering before, here is the way to do it. First, make certain with a piece of emery paper or glass paper, that you have the pieces to be soldered as clean as possible. The wire which you bind round will itself be shiny and bright so that it need not be cleaned any more than it is. Now get some Fluxite (which you get in a little tin – it's a brown material, rather like dripping), smear a little of this on where you are going to solder and then heat up your soldering iron, which in the case of an electric soldering iron merely means switching it on. As soon as you put the iron in contact with the flux and you hear a hiss and a bubble, you know it's about the right heat. If you use the kind of solder which has the flux already combined with it, you could do without the special flux as an addition. We usually use both to make quite certain. You rub this

Meccano steering unit from an R/C Jaguar model built by Mick Charles who may be better known for his superb R/C aircraft including Sheila Scott's record-breaker Comanche.



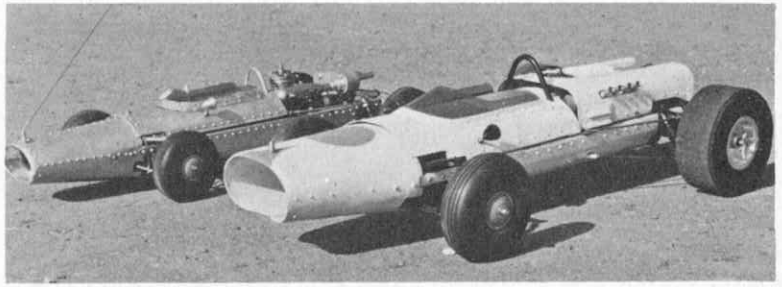


This shows the neat steering arrangement on J. A. Hadley's F/1 racer. Use of standard nuts and long bolts saves a great deal of more difficult work.

should be capable of alteration on the actual car before the day's work starts, but need not be changeable during running. You then have a car which has a bias to a left hand circle or a right hand circle when left alone, but a big circle which, to some extent, could be regarded as straight ahead.

We can now link up our steering unit to a servo so that it will give a left or right turn. This will be a positive left or a positive right, rather than a gradual and proportional turn such as you would give in a full-size car. This may give a rather jerky motion to the car and we will consider later if there are alternative and better methods. Generally when we achieve a better method in a gradual turn, we may find we have sacrificed some other advantage, so as in all simple models, it continues to be a

Metal-bodied car shown earlier with running mate in foreground. Cars like these can be obtained in this country – but are for more sophisticated equipment.



matter of compromise, we don't get the ideal arrangement with simplicity, but we get the best of a choice of different degrees of perfection.

Before we go more thoroughly into this, we should consider other alternatives in the way of simplicity. Some cars we have seen have been permanently offset for a small left- or right-hand circle and can be made to go straight ahead or to the opposite lock by a signal, and then revert to their previous position.

Another method is really a development of tank or half-track steering where, by reason of having a motor driving each driving wheel separately, if you stop one and leave the other running, you will tend then to go in a turn, using the stopped motor as the centre of the circle and for the running motor to bring you round the stopped item. For a tank or Bren-gun carrier where the half-track itself ceases to go forward, this gives you a skid turn. The same sort of skid turn is given by an auto cross, and trials drivers by what is known as the fiddle brake; it is not an ideal arrangement but can be quite effective.

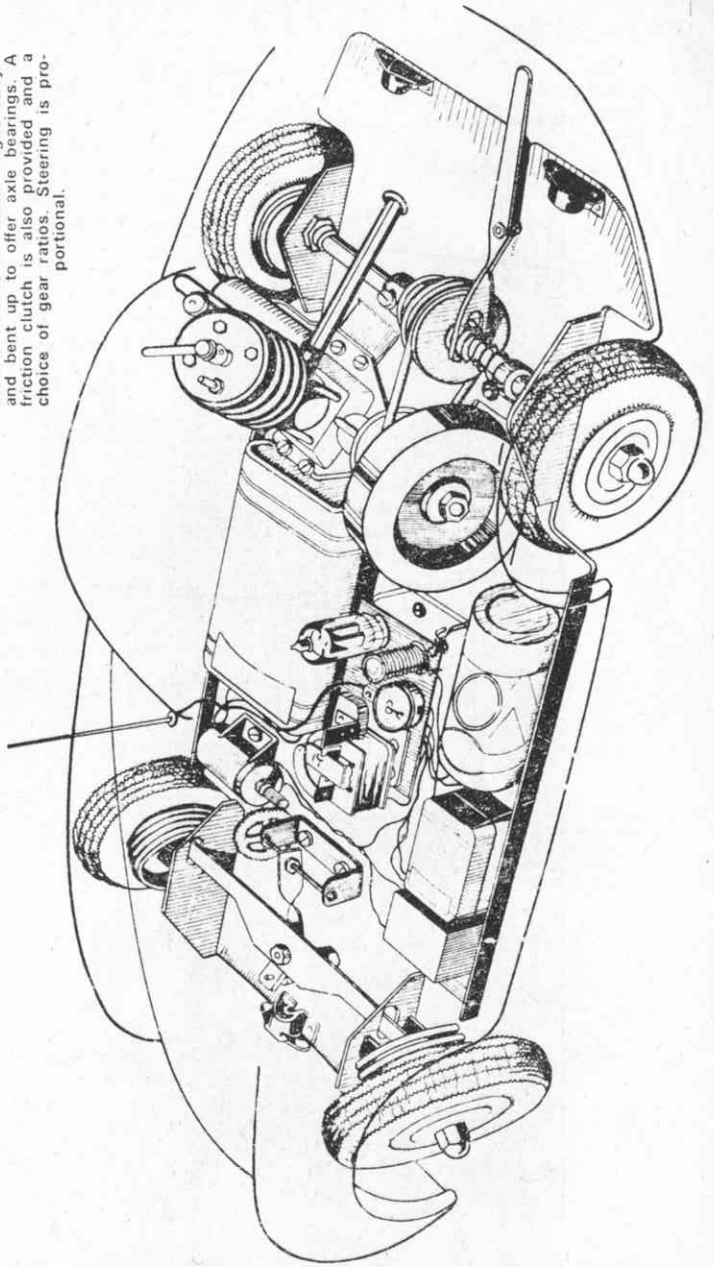
Another way that we have seen in a commercial radio control car project is to have an additional wheel concealed under the car, a kind of jockey wheel, on which the front end of the car rests, so that the two apparent steering moving wheels on the front do not, in fact, revolve but the whole thing goes on the front jockey wheel or gimbal wheel,

ELEMENTS OF STEERING GEAR

Whether you make up a car from scratch or whether you make use of a plastic kit, it will be necessary to make the steering gear up and discard the plastic steering pieces that you have got in the kit – they may be useful to you in helping you to decide the actual shape of the units of the steering gear, but are not robust enough for hard use.

The steering unit will comprise some sort of a beam which supports at each end what is known as a kingpost, and this kingpost is the part that swivels with the wheels. Attached to the kingposts are short stub-axles to which the front wheels are fitted. The kingposts will again be linked together with a track rod so that they must move in unison.

We need a device to connect up this track rod with our servo to give us the left and right turn. This takes the form of a further link in the centre of the track rod. The simplest way of building up the kingpost and the stub axle is with twisted wire which is then bound together with thin florist's wire or fuse wire and soldered. Simple brass cutout pieces can also be filed up. Since it is desirable that the left and the right hand bends are exactly the same insofar as left and right angles are concerned, a small jig should be built up. This can be done with panel pins nailed into any piece of scrap wood and will be used on next month's model. The sort of wire to use is either aeromodellers' piano wire which you can buy from your model shop in suitable thickness, or we can use bicycle spokes instead. However, as long as it is a stout wire, it doesn't really matter, in fact, in this very small size you could even use brass



Cutaway sketch of Mercedes-Benz model powered by small diesel motor. This has long been a popular design abroad (it even shows a valve receiver!) but is the finest basis for a modern model. Pan is of metal – light alloy – and bent up to offer axle bearings. A friction clutch is also provided and a choice of gear ratios. Steering is proportional.